

# E Annex

## E. Annual Maintenance Plan: On-grid. (Download it from [www.solarpowereurope.org](http://www.solarpowereurope.org))

The utility maintenance plan is conceived for a 3-5 MW site (land-locked site far from seashore). The distributed maintenance plan is conceived for a 50 kW to 1 MW fixed mount rooftop installation with secure access. The maintenance plan applies for both utility and distributed solar plants. For distributed, please take into account the following legend.

a: distributed: only if required; b: distributed: recommendation; c: distributed: not applicable; d: distributed: best practice

The abbreviations describe the importance and frequency of the maintenance tasks related to each component of the solar plant:

D: Daily; M: Monthly; Q: Quarterly; SA: semi-annual; Y: yearly; nY: every n years; T: Total installation; S: Defined subset; R: random subset.

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT	
Modules	Integrity inspection & replacement	Minimum requirement	Y	T	
	Thermography inspection	Recommendation	Y	T	
	Measurements inspection	if required	Y	S	
	Check tightening of clamps	Minimum requirement	Y	R	
	Modules cleaning	According to local conditions	(Y)	T	
	Sample internal inspection of junction boxes (if possible)	Recommendation	Y	T	
	Integrity check & cleaning	Minimum requirement	Y	T	
	Documents inspection	if required	Y	T	
	Check labelling and identification	Minimum requirement	Y	R	
	Electrical protections visual inspection & functional test	Minimum requirement	Y	T	
Electrical cabinets and switchboards	Check fuse status	Minimum requirement	Y	T	
	Check surge protection status (if applicable)	Minimum requirement	Y	T	
	Check integrity of cables & state of terminals	Minimum requirement <sup>a</sup>	Y	T	
	Sensor functional verification (if applicable)	Recommendation <sup>a</sup>	Y	T	
	Measurements inspection	Best practice <sup>a</sup>	Y	T	
	Thermographical inspection	Recommendation <sup>a</sup>	Y	T	
	Check tightening	Minimum requirement <sup>a</sup>	Y	T	
	Lubrification of locks	Minimum requirement <sup>a</sup>	Y	T	
	Monitoring operation test (if applicable)	Recommendation <sup>a</sup>	Y	T	
	Integrity inspection	Minimum requirement	Y	R	
Cables	Check labelling and identification	Minimum requirement	Y	R	
	Check cable terminals	Minimum requirement	Y	R	
	Measurements inspection	Recommendation	Y	R	
	Integrity check & cleaning	Minimum requirement	Y	T	
	Documents inspection	Best practice	Y	T	
	Check labelling and identification	Minimum requirement	Y	R	
	Electrical protections visual inspection, check correct operations	Minimum requirement	Y	T	
	Check fuses	Minimum requirement	Y	T	
	Check surge protections	Minimum requirement	Y	T	
	Thermographical inspection	Best practice <sup>b</sup>	Y	T	
Inverters	Sensors functional verification	Minimum requirement	Y	R	
	- DC / AC cables - Cables in switchboards, cabinets, inverters	Integrity inspection	Minimum requirement	Y	R
		Check labelling and identification	Minimum requirement	Y	R
		Check cable terminals	Minimum requirement	Y	R
		Measurements inspection	Recommendation	Y	R
		Integrity check & cleaning	Minimum requirement	Y	T
		Documents inspection	Best practice	Y	T
		Check labelling and identification	Minimum requirement	Y	R
		Electrical protections visual inspection, check correct operations	Minimum requirement	Y	T
		Check fuses	Minimum requirement	Y	T
Check surge protections		Minimum requirement	Y	T	
- Central inverters - String inverters	Thermographical inspection	Best practice <sup>b</sup>	Y	T	
	Sensors functional verification	Minimum requirement	Y	R	

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
Inverters - Central inverters - String inverters	Measurements inspection	Minimum requirement	Y	T
	Check parameters	Minimum requirement	Y	T
	Functional test of ventilation system	Minimum requirement	SA	T
	Check batteries	According to manufacturer's recommendations	(Y)	T
	Replace batteries		(3yr)	T
	Replace fans		(5yr)	T
Transformer ° - Power transformer - AUX transformer	Safety equipment inspection	Minimum requirement	Y	T
	Clean filters	Minimum requirement	SA	T
	Replace filters	Minimum requirement	2yr	T
	Integrity check & cleaning	According to local conditions	(Y)	T
	Check labelling and identification	Minimum requirement	Y	R
	Thermographical inspection	Best practice	Y	T
	Functional verification of sensors & relays	Minimum requirement	Y	T
	Check parameters	Minimum requirement	Y	T
	Check oil level (if applicable) and max. temperature	Minimum requirement	Y	T
	Check of cooling system (fans) if applicable	Minimum requirement	Y	T
MV switchgear incl. protection devices °	Check of MV surge discharger devices (if applicable)	Minimum requirement	Y	T
	Integrity check & cleaning	According to local conditions	(Y)	T
	Safety equipment inspection	Minimum requirement	Y	T
	Check labelling and identification	Minimum requirement	Y	R
	Electrical protections visual inspection	Minimum requirement	Y	T
	Thermographical inspection, if possible	Recommendation	Y	T
	Sensors functional verification	Minimum requirement	Y	T
	Measurements inspection	Minimum requirement	Y	T
	Check correct operation	Minimum requirement	Y	T
	Check fuse status	Minimum requirement	Y	T
	Check cables terminals	Minimum requirement	Y	T
	Battery / UPS check	Minimum requirement	Y	T
	Mechanical lubrication	According to manufacturer's recommendations and necessity	(5yr)	T
	Replace certain mechanical parts		(5yr)	T
	Battery / UPS replacement		(3yr)	T

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
MV switchgear incl. protection devices °	Check protection parameters	According to local grid code	(5yr)	T
	Functional check of protection devices		(5yr)	T
Power analyser °	Integrity check & cleaning	Minimum requirement	Y	T
	Check labelling and identification	Minimum requirement	Y	R
Energy meter	Measurements inspection	Minimum requirement	Y	T
	Software maintenance	Recommendation	Y	T
	Monitoring operation test	Minimum requirement	Y	T
	Check parameters	Minimum requirement	Y	T
	Integrity check & cleaning	Minimum requirement	Y	T
	Check labelling and identification	Minimum requirement	Y	R
	Check values and parameters	Recommendation	Y	T
	Check of communication devices (modem, converters) if applicable	Recommendation	Y	T
	Check batteries	According to manufacturer's recommendations	(Y)	T
	Replace batteries		(3yr)	T
UPS °	Functional verification		Y	T
	Integrity check & cleaning	Minimum requirement	Y	T
	Integrity check & cleaning	Minimum requirement	Y	T
	Check batteries	According to manufacturer's recommendations	(Y)	T
Emergency generator (if applicable) °	Replace batteries		(3yr)	T
	Functional test of ventilation system (if applicable)	Best practice	Y	T
	Integrity check & cleaning	According to manufacturer's recommendations	(Y)	T
	General maintenance		(Y)	T
	Check correct operation		(Y)	T
	Replacement of filters		(5yr)	T
Lights and electric sockets	Integrity check & cleaning	Minimum requirement	Y	T
	Check correct operation	Minimum requirement	Y	T
	Check conformity to local security standards	Minimum requirement	3yr	T
HVAC (if applicable)	Integrity check & cleaning	According to manufacturer's recommendations	(Y)	T
	Functional verification		(Y)	T
	Change of air filters		(Y)	T

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
Water supply system (if applicable)	Integrity inspection	If applicable	Y	T
Fire detection central (if applicable)	Integrity check & cleaning	According to manufacturer's recommendations and local requirements	(Y)	T
	Check correct operation		(Y)	T
	Battery inspection		(Y)	T
	Sensors functional verification		(Y)	T
	Cleaning of cameras & sensors		(Y)	T
Lightning protection (if applicable)	Integrity inspection	Minimum requirement	Y	R
Fences and gates	Integrity inspection	Minimum requirement	Y	T
	Lubrication of locks	Minimum requirement	SA	T
Vegetation	Vegetation clearing	According to local conditions	(Q)	T
Paths	Integrity inspection	Best practice	Y	T
	Vegetation clearing	Recommendation	Y	T
Drainage System	General cleaning	Minimum requirement	SA	T
Manholes	Integrity inspection	Best practice	Y	T
Buildings	Integrity check & cleaning	According to local requirements	(Y)	T
	Lubrication of locks	Minimum requirement	SA	T
	Documents inspection	According to local requirements	(Y)	T
	Check fire extinguishers		(Y)	T
	Check earthing		(3yr)	T
Safety equipment	Integrity check & cleaning	Minimum requirement	Y	T
	Check correct operation	Minimum requirement	Y	T
PV support structure	Integrity inspection	Minimum requirement	Y	R
	Check tightening	Minimum requirement	Y	R
	Check potential equalization	Minimum requirement	2/yr	T
Tracker system °	Integrity check & cleaning	Minimum requirement	Y	T
	Check correct operation	According to manufacturer's recommendations	(Y)	T
	Check tightening		(Y)	R
	General maintenance		(Y)	T
	Mechanical lubrication		SA	T

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
Weather station <sup>d</sup>	Integrity check & cleaning	According to manufacturer's recommendations	(Y)	T
	Functional test of sensors		(Y)	T
	Check correct operation		(Y)	T
	Check batteries (if applicable)		(Y)	T
	Monitoring operation test		(Y)	T
Irradiation sensors	Integrity check & cleaning	According to manufacturer's recommendations and local requirements	Q	T
	Calibration		2yr	T
	Monitoring operational test		Y	T
Communication Board	Functional communications check	Minimum requirement	D	T
	Integrity check & cleaning	Minimum requirement	Y	T
Intrusion detection and verification system <sup>c</sup>	Functional verification of intrusion detection	According to manufacturer's recommendations	(Y)	T
	Functional verification of alarming		Y	T
	Functional verification of cameras		M	T
	Specific maintenance		Y	T
	Inventory of stock		Y	T
Stock of spare parts <sup>d</sup>	Visual inspection of stock conditions	Minimum requirement	Y	T
	Stock replenishment	Minimum requirement	M	T

# F Annex

## F. Annual Maintenance Plan: Standalone off-grid systems. (Download it from [www.solarpowereurope.org](http://www.solarpowereurope.org))

The standalone PV maintenance plan is conceived for a 10–300 kWp site.

The abbreviations describe the importance and frequency of the maintenance tasks related to each component of the solar plant:

D: Daily; M: Monthly; Q: Quarterly; SA: Semi-annual; Y: Yearly; nYr: Every n years; T: Total installation; S: Defined subset; R: Random subset.

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
Modules	Integrity inspection & replacement of broken modules	Minimum requirement	Y	T
	Check tightening of clamps	Minimum requirement	Y	R
	Modules cleaning	According to local conditions	(Y)	T
	Integrity check & cleaning	Minimum requirement	Y	T
	Documents inspection (if applicable)	Best practice	Y	T
	Check labelling and identification	Best practice	Y	R
	Electrical protections visual inspection & functional test	Minimum requirement	Y	T
	Check fuse status	Minimum requirement	Y	T
	Check surge protection status (if applicable)	Minimum requirement	Y	T
	Check integrity of cables & state of terminals	Minimum requirement	Y	T
Electrical cabinets and switchboards - Array/string junction box - Generator junction box - AC switchboards	Measure Uoc and Isc of individual strings	Best practice	Y	T
	Check tightening of terminals	Minimum requirement	Y	T
	Lubrication of locks	Minimum requirement	Y	T
	Integrity inspection (where accessible)	Minimum requirement	Y	T
	Check labelling and identification	Best practice	Y	R
	Check cable terminals	Minimum requirement	Y	T
	Integrity check & cleaning	Minimum requirement	Y	T
	Documents inspection	Best practice	Y	T
	Check labelling and identification	Best practice	Y	R
	Electrical protections visual inspection, check correct operations	Minimum requirement	Y	T
Cables - DC / AC cables - Cables in switchboards, cabinets, inverters	Check surge protection (if applicable)	Minimum requirement	Y	T
	Check error log	Best practice	Y	T
	Integrity check & cleaning	Minimum requirement	Q	T
	Documents inspection	Best practice	Y	T
	Performance test of inverter (10 min at maximum rated power)	Best practice, according to manufacturer's recommendations	Y	T
	Check labelling and identification	Best practice	Y	R
	Electrical protections visual inspection, check correct operations	Minimum requirement	Y	T
	Check fuses	Minimum requirement	Y	T
	Check surge protection	Minimum requirement	Y	T
	Functional test of ventilation system	Minimum requirement	SA	T
Charge controller	Clean filters	Minimum requirement	Q	T
	Replace filters	According to local conditions	(2yr)	T
	String inverters / charge controller			

EQUIPMENT	TASK	IMPORTANCE	FREQUENCY	EXTENT
Batteries	Integrity check & cleaning (especially the terminals)	Minimum requirement	Y	T
	Thermography of battery terminals	Best practice	Y	T
	Check the electrolyte level in each cell (VRLA)	Minimum requirement *	Q	T
	Check batteries, for example - Measure float voltage and current of the entire bank - Measure terminal voltage of individual batteries - Visual check of state of sulfation (VRLA) - Check specific gravity of electrolyte (VRLA) - Check voltage balance and internal temperature (LIB) - Check status / error log of battery management system (LIB, if available)	According to manufacturer's recommendations	(Y)	T
Emergency generator (if applicable)	Replace batteries		(3yr)	T
	Functional test of ventilation system (if applicable)	Minimum requirement	SA	T
	Integrity check & cleaning	According to manufacturer's recommendations	(Y)	T
Lightning protection (if applicable)	General maintenance		(Y)	T
	Check correct operation		(Y)	T
	Replacement of filters		(5yr)	T
Fences and gates	Integrity inspection	Minimum requirement	Y	R
	Integrity inspection	Minimum requirement	Y	T
	Lubrication of locks	Minimum requirement	SA	T
Vegetation	Vegetation clearing	According to local conditions	(Q)	T
	Integrity inspection	Minimum requirement	Y	R
PV support structure	Check tightening	Minimum requirement	Y	R
	Check potential equalization	Minimum requirement	2yr	T
	Check for completeness	Minimum requirement	Y	T
Spare parts	Complete spare parts	According to manufacturer's recommendations	(Y)	T
		* Best practice: monthly		